1. *Course number and name*

**ENGR 478: Design with Microprocessors**

1. *Credits and contact hours*

4 credits

Contact hours: two 75-minute lecture sessions/week and one 2-hour-45-minute lab session/week; engineering topic

1. *Instructor’s or course coordinator’s name*

Instructor: Ian Donovan

Course coordinator: Xiaorong Zhang

1. *Text book, title, author, and year*

# No required text book.

1. *other supplemental materials*

Lab material:

* Tiva C Series TM4C123G LaunchPad Evaluation Kit (EK-TM4C123GXL)

Other references:

# Jonathan Valvano. Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers, Fifth Edition (Volume 1), 2019. ISBN: 978-1477508992

* Tiva TM4C123GH6PM Microcontroller Data Sheet
* Getting Started with the Tiva TM4C123G LaunchPad Workshop Student Guide and Lab Manual
* TivaWare Peripheral Driver Library User’s Guide
* Tiva C Series TM4C123G LaunchPad Evaluation Board User’s Guide.
* Cortex-M4 Technical Reference Manual
* Cortex-M4 Devices Generic User Guide
* Cortex-M3/M4F Instruction Set Technical User’s Manual
* Supplemental online content (videos, web-based tools, etc.) delivered via course webpage
1. *Specific course information*
* *brief description of the content of the course (catalog description)*

Assembly language programming. System bus. Interfacing with memory and I/O devices. Serial and parallel communications. Timer and counter functions. Polling and interrupt. A-D conversion. Fuzzy logic.

* *prerequisites or co-requisites*

ENGR 356: Digital Design; ENGR 213: Introduction to C Programming for Engineers or CSC 210: Introduction to Computer Programming; or equivalents with grades of C- or better.

* *indicate whether a required, elective, or selected elective course in the program*

Required for Computer Engineering and Electrical Engineering Programs.

1. *Specific goals for the course*
2. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*

Students completing the course successfully will demonstrate

* In-depth knowledge of the internal organization of microprocessors/microcontrollers, the interactions between software and hardware, as well as the requirements and trends of microcontroller-based applications.
* Proficiency in programming microcontrollers using Assembly and C programming languages, and integrating software and hardware for microcontroller-based systems.
* Ability to interface microcontrollers with other devices through serial and parallel I/O interfaces, and effectively work with analog signals in digital systems.
* Competency in using timer and counter functions, designing expanded systems with external circuits, and utilizing development tools for microcontroller programming.
* Ability to design, implement, and evaluate a microcontroller-based embedded system in a team, and effectively present the developed system in both oral and written formats.
1. *explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

Course addresses ABET Student Outcome(s): 1, 2, 3, 5, 6, 7

1. *Brief list of topics to be covered*
* Introduction to the microcontrollers and embedded systems
* ARM Cortex-M4 architecture; Assembly instruction set
* Logic operations; Parallel I/O; Embedded C programming
* Switch and LED interfacing; IO synchronization
* Timers; Interrupt concept
* Edge-triggered interrupt
* Periodic interrupt
* Interrupt context switch
* Serial communication; UART
* Analog to digital conversion (ADC)
* Serial I/O – SSI vs. UART vs. USB vs. I2C
* Timing analysis
* Power management
* Advanced topics in embedded system design